THE TECHNICAL ISSUE

Narrow gap technology revolutionises thick plate welding at Borsig

Cloos robot system guarantees efficiency and quality

Technical Issue of S. Nuechtern-Baumhoff, Carl Cloos Schweisstechnik GmbH, Haiger Photos: CLOOS

Borsig Process Heat Exchanger GmbH produces appartus for cooling gases at high temperatures and pressures for the chemical and petrochemical industry. For welding the thick walled apparatus, the Berlin company recently invested in a robot system from the Haiger-based welding specialists Carl Cloos Schweisstechnik GmbH. While the use of MIG/MAG narrow gap welding enabled Borsig to make considerable savings in production time and costs, this new technology also increases quality.

As one of Germany's oldest and most traditional firms, Borsig can look back over 175 years of experience in the development and production of tailor-made components for industrial systems. Its successful product range includes custom apparatus and custom heat exchangers, e.g. waste heat systems for methanol-, ammonia- and nitric acid systems and cracked gas coolers for generating ethylene. It also supplies piston- and turbo-compressors, systems for emissions protection and the recovery of hydrocarbons and it provides comprehensive services for the power station sector and the chemical industry. Borsig employs a total of 650 staff at a number of sites throughout Germany and its head office is in Berlin.

Special heat exchangers permit efficient cooling of process gases

Borsig Process Heat Exchanger GmbH in Berlin is expert in the cracked gas coolers used in numerous petrochemical systems. These are used because ethylene is essential for the manufacture of bulk plastics. While it does occur naturally, meeting global demand necessitates its production in huge plants on an industrial scale. Hydrocarbons recovered from mineral oil are thermally broken down in cracking stills at around 1000°C. The result is so-called cracked gas, which amongst other things, contains ethylene. To obtain a maximum yield of ethylene, the cracked gas must be cooled very rapidly to somewhere below 400°C. The cracked gas coolers from Borsig facilitate his process. The Berlin company is the world market leader in this area. Since it underwent insolvency in the year 2002, Borsig has experienced steady growth. In fact, the turnover of Borsig Process Heat Exchanger has more than trebled in the last ten years.

Borsig's custom heat exchangers facilitate efficient cooling of process gases and are used in numerous chemical and petrochemical systems.

Borsig exports around 95% of its apparatus to the Middle East and Asia. Due to the current shale gas boom it is also selling in significant quantities to the USA. Since 2008 therefore, the company has had a direct link to the waterways with the Borsig harbour so that apparatus on any scale can be transported directly from Berlin along the waterways to anywhere in the world without problem.

Welding technology is core competence

The business unit in Berlin has around 16,700 m² production area and crane capacity of 250 t. Welding technology is one of its core competencies. This includes, for example the laser-controlled weld scanning system for submerged narrow gap welding, the use of robot welding technology for MAG welding in high-pressure equipment production, MAG narrow gap robot technology with integrated 3D firing technology, TIG hot wire welding, RES and submerged-arc strip cladding, automated pipe welding, including internal bore welding up to 500 mm and the qualified processing of all steel and nickel-based alloys.

The customers expect flawless quality since the safety requirements for equipment for hazardous gases are enormously high. If a complex chemical system breaks down, the operator faces considerable costs. Therefore material quality is extremely important and is subject to strict requirements which not everyone is able to meet. According to Andreas Förster, production manager at Borsig Process Heat Exchange GmbH, the apparatus, particularly from Asian competitors, often fail to meet the high quality requirements of customers. However, the competition on the global market is becoming more intense. "To ensure long-term competitiveness, we have to invest in automation and innovative processes " says Förster, and continues "Since we do not manufacture standard products, focusing instead on custom systems, we face enormous challenges".

MIIG/MAG narrow gap technology greatly reduces welding time

In the latest system from Cloos, the robots use the MIG/MAG narrow gap technology to weld connecting pieces with diameters from 250 to 500 mm to the apparatus housing. This process offers a particular economic efficiency for welding thick-walled components. At the heart of narrow gap welding technology is the rectangular, in this case 400 mm long, narrow gap blade which guides the wire electrode, inert gas and the cooling water and can penetrate particularly deep gaps. Due to the very small opening angle there is no extensive weld preparation and the quantity of filler material and shielded gas can be reduced. The results speak for themselves at Borsig. Compared to submerged welding Borsig has been able to reduce its welding time per se by almost 50%.

Production wage costs have been reduced by almost 70% because the second person needed for suction in the submerged connecting piece welding process is not needed in the MSG narrow gap process. With up to 50% reduced costs for welding filler materials, Borsig has made around 80% total cost reductions in its connecting piece welding. The company is also saving around 50% on filler materials. Since thick components can be welded with almost parallel edges, there is also less distortion.

The weld seams with the typical constant seam structure meet the highest quality demands. To ensure first-class quality, each connecting piece is subjected to a 100% volume check. The sensor compares tolerances between the programmed tracks and the actual positioning of the workpieces. The robot is fitted with two sensors.

The 400 mm long, rectangular narrow gap blade is the heart of the narrow gap welding technology and can penetrate particularly deep gaps.

The tactile sensor detects the start and end positions based on an electromechanical sensing principle and corrects the programmed welding section accordingly. During the welding, the arc sensor measures whether the burner position actually agrees with the programmed track. Loss of time is minimised because measuring and welding take place simultaneously with the arc sensor. At the same time, workpiece distortion, e.g. due to thermal expansion, is directly compensated for. The Cloos arc sensor thus combines productivity with optimised quality.

The robot system is equipped with a tactile and an arc sensor which balance the tolerances between the programmed paths and the real component positions.

Automation ensures competitiveness

The automation of the Berlin production site is set to continue. The company currently has two Cloos robot systems in operation. In June, another Cloos flame cutting robot will be added. Production manager Förster praises the unique combination of robot and welding technology and the extensive training provided by Cloos.

"To ensure that we can fully exploit this innovative technology, Cloos has supported us in the intensive training of our staff. Because of course our staff also had to become familiar with the new process. Now everyone is at home with the new system" says Förster contentedly. An added benefit: since the robot carries out the heavy physical labour, the general hazards posed by arc radiation and welding fumes are reduced. The welder can concentrate far more on the process monitoring.

Production manager Andreas Förster (right) depends on CLOOS when it comes to welding technology. The successful undertaking is in the hands of Volker Hedergott (left), manager of the CLOOS branch in Berlin.

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